



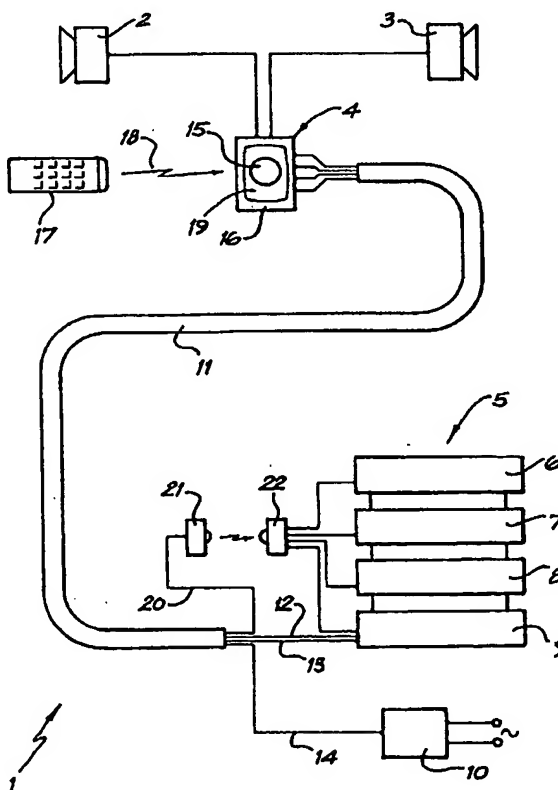
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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| <p>(51) International Patent Classification <sup>6</sup> :<br/>H04R 3/12, 5/04, H04S 1/00</p>  | <p>A1</p> | <p>(11) International Publication Number: <b>WO 99/09787</b><br/>(43) International Publication Date: 25 February 1999 (25.02.99)</p>  |
| <p>(21) International Application Number: PCT/AU98/00647<br/>(22) International Filing Date: 14 August 1998 (14.08.98)<br/>(30) Priority Data:<br/>PO 8621 15 August 1997 (15.08.97) AU<br/>(71) Applicants (for all designated States except US):<br/>LEISURETECH ELECTRONICS PTY. LTD. [AU/AU];<br/>Unit 7, 620 Botany Road, Alexandria, NSW 2015 (AU).<br/>ANDREWS, Leonard, Colin [AU/AU]; Unit 7, 620 Botany<br/>Road, Alexandria, NSW 2015 (AU).<br/>(74) Agent: F. B. RICE &amp; CO.; 605 Darling Street, Balmain, NSW<br/>2041 (AU).</p> |           | <p>(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR,<br/>BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE,<br/>GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ,<br/>LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW,<br/>MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL,<br/>TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO<br/>patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian<br/>patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European<br/>patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR,<br/>IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF,<br/>CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).</p> <p>Published<br/>With international search report.</p> |

## (54) Title: A DISTRIBUTED STEREO SYSTEM

## (57) Abstract

This invention concerns a distributed stereo audio system (1). Distributed stereo audio systems are used to provide stereo sound to several rooms or areas from a single source of signal. The system includes two or more speakers (2, 3) for the broadcast of stereo audio signals; a source of stereo audio signals; a stereo amplifier (4) to amplify stereo audio signals and drive the speakers; and a mains operated electrical power supply (10) to provide power to the amplifier. The amplifier is located in the same room as the speakers, and remote from the signal source and power supply. The amplifier is connected to the signal source and power supply by means of a category 5 four pair twisted cable (11) which provides, in respective twisted pairs, right channel audio signals (12) from the signal source to the amplifier, left channel audio (13) from the signal source to the amplifier, DC power (14) from the power supply to the amplifier, and control signals (20) from the amplifier to the signal source.



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## "A DISTRIBUTED STEREO SYSTEM"

### Technical Field

5 This invention concerns a distributed stereo audio system. Distributed stereo audio systems may be used to provide stereo sound to several rooms or areas from a single source of audio signals.

### Background Art

10 A typical stereo audio system comprises several audio signal sources such as a CD player and a tuner. The source units are generally arranged in a stack together with a selector and amplifier unit. In use, a signal from a selected source is amplified and provided to speakers which are typically located some distance away from the unit within the same room. The system controls are manually operable switches and dials on the signal sources and  
15 amplifier. There is sometimes a hand-held control device which is used to transmit infrared signals to the selector and amplifier unit.

In sophisticated systems several sets of speakers may be mounted in different rooms throughout a house. Sometimes the selector and amplifier unit will be provided with switches to enable different sets of speakers to be  
20 activated and deactivated. To power multiple speakers from a single amplifier an impedance matching device is also required.

The amplifier's volume control, which controls the volume level in the main room, also controls the volume level of the speakers in remote rooms. The remote rooms may have an attenuator device to reduce volume level but  
25 this attenuator can only reduce the volume below the level set by the amplifier. The attenuator cannot increase the amplifier's output.

The quality of the components and the weight and quality of the cabling can easily affect the quality of the sound output by the speakers. These systems also require specialist knowledge in the installation of the  
30 cabling and the audio components.

### Summary of the Invention

35 The invention is a distributed stereo audio system, including: two or more speakers for the broadcast of stereo audio signals; a source of stereo audio signals; a stereo amplifier to amplify stereo audio signals and drive the speakers; and a mains operated electrical power supply to provide power to

the amplifier. The amplifier is located in the same room as the speakers, and remote from the signal source and power supply. The amplifier is connected to the signal source and power supply by means of a category 5 four pair twisted cable which provides, in respective conductors of the twisted pairs, right channel audio signals from the signal source to the amplifier, left channel audio from the signal source to the amplifier, and DC power from the power supply to the amplifier.

The right channel audio, left channel audio and DC power may be provided in respective twisted pairs.

This system enables decentralisation of amplification, and permits the amplifier to be installed remote from the signal source and close to the speakers, reducing speaker cable loss and increasing total system damping factor. The remote amplifier does not need to be positioned close to a voltage source since it receives its power via the category 5 four pair twisted cable.

The cabling is very simple and easy to install. One CAT5, or similar, cable connects the source of audio signals, to each room or zone. This cable carries audio signal, system power, and if required, data and status. Digital systems can also carry video transmission. More of the cables can be laid in parallel if higher power or bi-amplification is required.

The cabling can be adapted to many different configurations. It is possible to install it into every major room in new homes. Once the cabling is installed the system can be configured in many different ways. It could start as a one-room system and be changed and upgraded to an audiophile standard multi-zone system feeding individual source selection to each room utilising the same cabling.

The cabling is capable of adapting to new technologies and system upgrades without the need to re-cable when upgrades are required; for instance, it can also be used to transmit digital audio, video and control commands.

Remote amplifier and speaker sets may be positioned in several rooms, and may receive signals from a single source of audio signals. Where the source provides a selection of components, such as radio or CD, it is also possible for different audio signals to be provided to different rooms. The volume may be set differently, up or down, in each room.

The remote amplifiers are integrated circuit amplifiers. As a result of not requiring built-in power supplies they may be compact, and they may be

constructed to fit into a standard electrical light switch housing or be incorporated into a speaker box or in-wall or in-ceiling speaker. A suitable example is the Silicon Monolithic, Bipolar Linear Integrated Circuit, TA8216H, dual audio power amplifier.

5       The remote amplifiers can be powered by low cost plug packs or by dedicated audiophile power supplies located at the audio source, where mains power is easily accessible.

10       The remote amplifiers' output levels may be controlled by the output levels of the source components, or a manual volume control maybe included with respective remote amplifiers. Alternatively, a hand-held remote control may be provided for volume control, among other things. In this case, the remote control may transmit infrared signals to a receiver mounted with a remote amplifier. Where a remote amplifier is mounted inside a standard electrical light fitting the fascia plate may include an infrared receiver. The  
15       fascia plate may also include status indicators for the amplifier and the audio signal source components.

      Infrared signals received by a remote amplifier may be transmitted to the source components through a fourth twisted pair in the category 5 cable. The signals may be modulated before transmission to an infrared emitter  
20       which directly controls the audio components, or they may be demodulated and provided as data signals to those components.

      The system can also carry control data in the single cable to control other remote controllable items which are located in the same areas or those which can be incorporated into the single wiring system. Infrared is now a  
25       common data language. Many domestic appliances are controlled by infrared remote control. The remote infrared receivers may relay commands for all infrared devices operating between 38-500 kHz.

      The remote amplifiers may accept standard line level signals from the audio source components, or speaker outlet of a master amplifier which may  
30       be matched to the audio source, or sources, and may be located with them. In other words, the remote amplifiers may be driven by either a low impedance (4 to 16 ohm) speaker level signal, or high impedance (10k ohm) line level signal.

      The remote amplifiers may include a switchable muting system, and  
35       they may include an adjustable input level trim device.

A high input impedance at the remote amplifiers will cause any inducted line signals to be conducted back to the lower impedance of the audio source, reducing induced system noise at the amplifier. High impedance will also allow many remote amplifiers to be run from a single audio source with no sonic detriment. Multiple pairs of speakers may be driven from a single audio source in this way without the need for speaker impedance matching devices.

The output from the remote amplifiers is sufficient to drive a pair of hi-fi speakers, 4 to 16 ohm, at a reasonable sound level for most domestic requirements; typically 90-100dB unweighted. The remote amplifiers do not require fused output protection.

#### **Brief Description of the Drawing**

Examples of the invention will now be described with reference to the accompanying drawings, in which:

Figure 1 is a schematic diagram of a first example; and  
Figure 2 is a schematic diagram of a second example.

#### **Best Modes for Carrying out the Invention**

Referring first to Figure 1, the distributed stereo audio system 1 comprises two speakers 2 and 3 connected to an amplifier 4. The amplifier 4 is housed in a standard electrical light switch housing in the same room as the speakers.

In another room, a source of audio signals 5 comprises a CD player 6, a tape recorder 7, a VCR 8 and a source selector 9. A power supply 10 provides power from the mains to each amplifier 4.

The amplifier 4 is connected to the signal source and power supply 10 by means of a category 5 four pair twisted cable 11. One of the twisted pairs 12 provides the right audio signal from the source to amplifier 4. Another twisted pair 13 provides the left audio signal. A third twisted pair 14 provides power from power supply 10 to the amplifier 4.

In use amplifier 4 amplifies the left and right standard line level signals and supplies them to the speakers 2 and 3 respectively. The amplifier is controlled by operation of a potentiometer 15 mounted on its fascia plate

16.

Amplification may also be controlled by means of a hand-held remote controller 17 which transmits infrared signals 18 to a receiver 19 mounted in fascia plate 16. The fascia plate may include displays indicating the status of the amplifier and, if required, the components of the source. The fascia plate  
5 may also be used as a key-pad to transmit control commands to the sources.

Infrared signals may be transmitted, either before or after demodulation, from amplifier 4 back to source 5 using the fourth twisted pair 20 in category 5 cable 11. The infrared signals may be used to control the source directly. Alternatively, they may be used to retransmit the control  
10 signals using transmitter 21 to an infrared receiver 22 associated with the source.

Amplifier 4 is designed around a single chip amplifier, and has high input impedance. This enables several amplifiers to be mounted in different rooms to amplify signals from the same source 5 for speaker sets in each of  
15 those rooms. the Silicon Monolithic, Bipolar Linear Integrated Circuit, TA8216H, dual audio power amplifier is used for this purpose.

In each room the sound broadcast may be from the same component of the source, or from different components of the source. Further the amplification level may be different in each room.

Referring now to Figure 2, a slightly more complicated system will be described. In this system a connecting block 23 is used to interconnect the source of audio signals 5, the power supply 10, several category 5 four pair twisted cables 11 (two of which are shown), and the infrared emitter 21. The source selector 9 provides audio input, at line or speaker level, to the block  
20 23 along lines 24. The block then outputs these signals to respective twisted pairs of the category 5 cables 11, together with electrical power. One of the category 5 cables is connected as before, but the other terminates in an amplifier 25 mounted with one of a pair of ceiling mounted speakers 26 and 27 in another room. This amplifier module may be equipped with an  
25 infrared receiver 19 in its fascia plate, and control signals may be transmitted back to base as before.

Although the invention has been described with reference to a particular example, it should be appreciated that it may be exemplified in different forms. For instance, the source audio signal can come from a main  
35 amplifier or any line level output or amplifier speaker output. It can even have its own input switching or work in parallel with line level outputs

connected to an amplifier. A line driver of some kind may be used but it is not necessarily required. No impedance matching devices are required. For more sophisticated systems each remote amplifier may have its own source selection but this is not necessarily required.

5        During construction of a new building a facility for stereo broadcast can be economically installed into every major room. A four pair twisted cable (CAT5 or equivalent) is laid from a common control point to a point in each room where a remote amplifier may be installed. A loop wiring system may be used, however, this is not preferred since it may restrict the system's  
10 flexibility and power capability. Short lengths of speaker cable may be installed to speaker points in the walls or ceilings or wired directly to the speaker terminals. Using this cabling it is possible to install a remote amplifier into any room as and when required. More sophisticated multi-zone systems can be installed using the same cabling system.

15        Wiring at each end of the cable is a simple 8 way colour encoded connection. (It can also be a standard plug connector). No consideration has to be given to impedance matching, multiple modules can be run from the main system amplifier or a dedicated input selector or a single source component, eg. a CD player via line level. The volume level is infinitely  
20 variable and the main systems volume level does not affect the speakers in remote rooms. No remote mains power source is required.

A connecting block may be provided to interconnect the power supply, audio signal sources, main amplifier, infrared emitter to control the local sources and the remote amplifier and speaker sets. A four pair twisted  
25 (CAT5) cable is used to connect the connecting block with every remote amplifier.

In the Underwriters Labs (UL) Level classification system, there are 5 levels of increasing quality cabling.

In work paralleling UL's efforts, the American National Standards  
30 Institute's (ANSI) Electronic Industry Association/Telecommunication Industry Association (EIA/TIA) has developed similar standards to rate UTP.

The UL system harmonised with the EIA/TIA category system, and UL categories 3-5 now correspond exactly to EIA/TIA 568A categories.

EIA/TIA 568A incorporates all of the relevant areas of 568, TSB-36,  
35 TSB-40A, and TSB-53. The standard covers 100 ohm UTP, 150 ohm STP, and



fibre optic cabling. The EIA/TIA category rating system identifies categories 3, 4 and 5 for data applications.

5       Category 5 applies to UTP cables and associated connecting hardware with transmission characteristics up to 100mhz. Its application is ATM over copper TP-PMD 100Base-X.

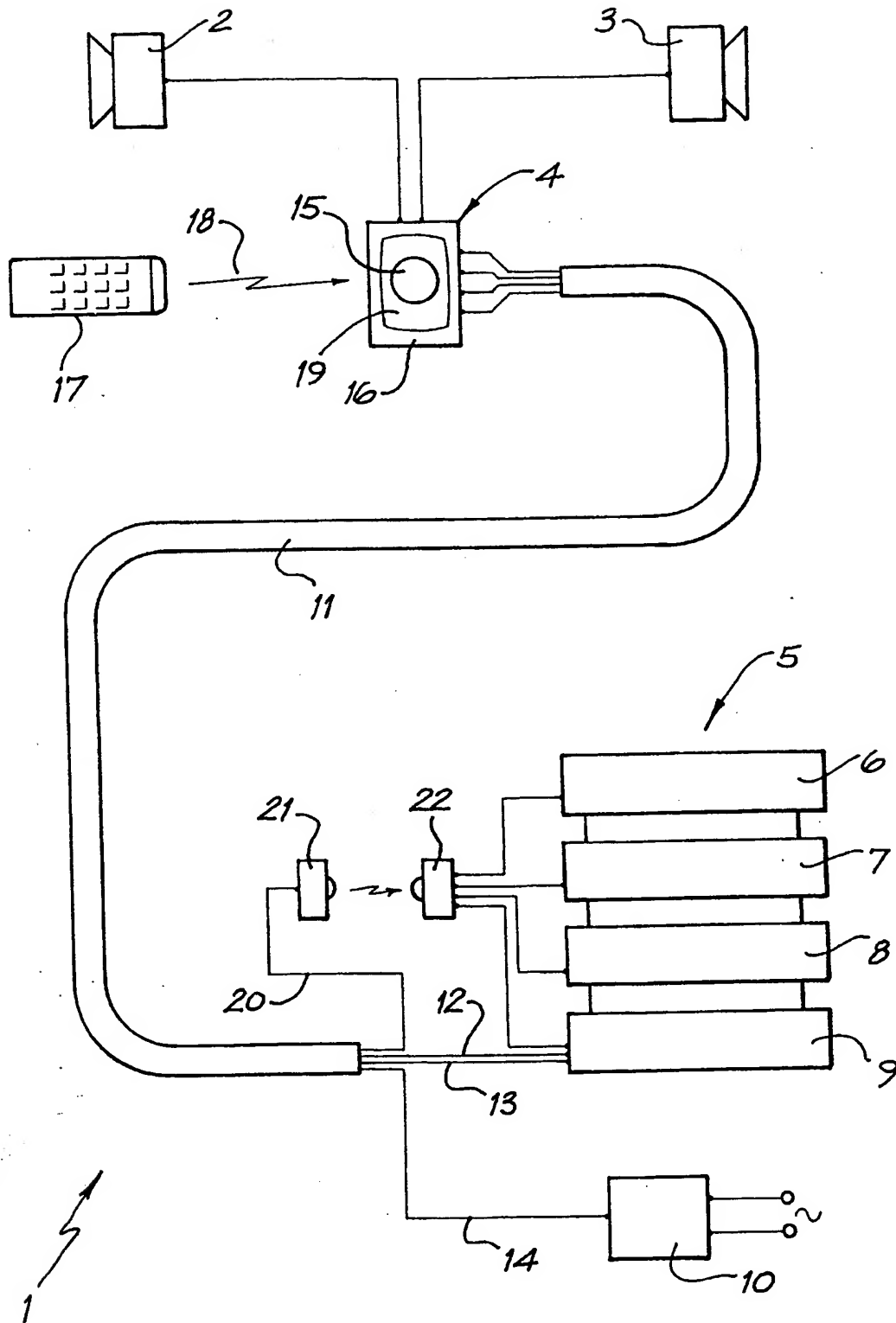
      Most field test equipment verify category 5 conformance by checking the link's performance against EIA/TIA 568A Annex E requirements.

10       It will be appreciated by persons skilled in the art that numerous variations and/or modifications may be made to the invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive.

**CLAIMS:**

1. A distributed stereo audio system, including: two or more speakers for the broadcast of stereo audio signals, a source of stereo audio signals, a stereo amplifier to amplify stereo audio signals and drive the speakers, and a mains operated electrical power supply to provide power to the amplifier; where the  
5 amplifier is located in the same room as the speakers, and remote from the signal source and power supply; and where the amplifier is connected to the signal source and power supply by means of a category 5 four pair twisted cable (or similar) which provides, in respective conductors of the twisted  
10 pairs, right channel audio signals from the signal source to the amplifier, left channel audio from the signal source to the amplifier and DC power from the power supply to the amplifier.
2. A distributed stereo audio system according to claim 1, where  
15 amplifier and speaker sets in several rooms receive signals from a single source of audio signals.
3. A distributed stereo audio system according to claim 1, where the source provides a selection of components, such as radio or CD, and different audio signals are provided to different rooms.
4. A distributed stereo audio system according to claims 1, 2 or 3, where  
20 the volume is set differently in each room.
5. A distributed stereo audio system according to any preceding claims, where the amplifier is based on an integrated circuit amplifier.
6. A distributed stereo audio system according to claim 5, where the amplifier is constructed to fit into a standard electrical light switch housing.
- 25 7. A distributed stereo audio system according to claims 1, 2 or 3, where the amplifier output level is controlled by the output level of the source components.
8. A distributed stereo audio system according to claims 1, 2 or 3, where a manual volume control is included with the amplifier.
- 30 9. A distributed stereo audio system according to claims 1, 2 or 3, where a hand-held remote control is provided to transmit infrared signals to a receiver mounted with the amplifier.
10. A distributed stereo audio system according to claim 9, where the amplifier is mounted with a speaker.

11. A distributed stereo audio system according to claim 9, where the amplifier is mounted inside a standard electrical light fitting and the fascia plate includes an infrared receiver.
12. A distributed stereo audio system according to claim 11, where the  
5 fascia plate also includes status indicators for the amplifier and the audio signal source components.
13. A distributed stereo audio system according to claims 9, 11 or 12, where infrared signals received by the amplifier are transmitted to the source components through a fourth twisted pair in the category 5 cable.
- 10 14. A distributed stereo audio system according to claim 13, where the signals are modulated before transmission to an infrared emitter which directly controls the audio components.
15. A distributed stereo audio system according to claim 13, where the signals are demodulated and provided as data signals to the audio  
15 components.
16. A distributed stereo audio system according to claim 1, where the amplifier accepts standard line level signals from the audio source components.
17. A distributed stereo audio system according to claim 1, where the  
20 amplifier accepts speaker signals from another amplifier.
18. A distributed stereo audio system according to claim 1, where the amplifier includes a switchable muting system.
19. A distributed stereo audio system according to claim 1, where the amplifier includes an adjustable input level trim device.



**FIG. 1**  
SUBSTITUTE SHEET (Rule 26)

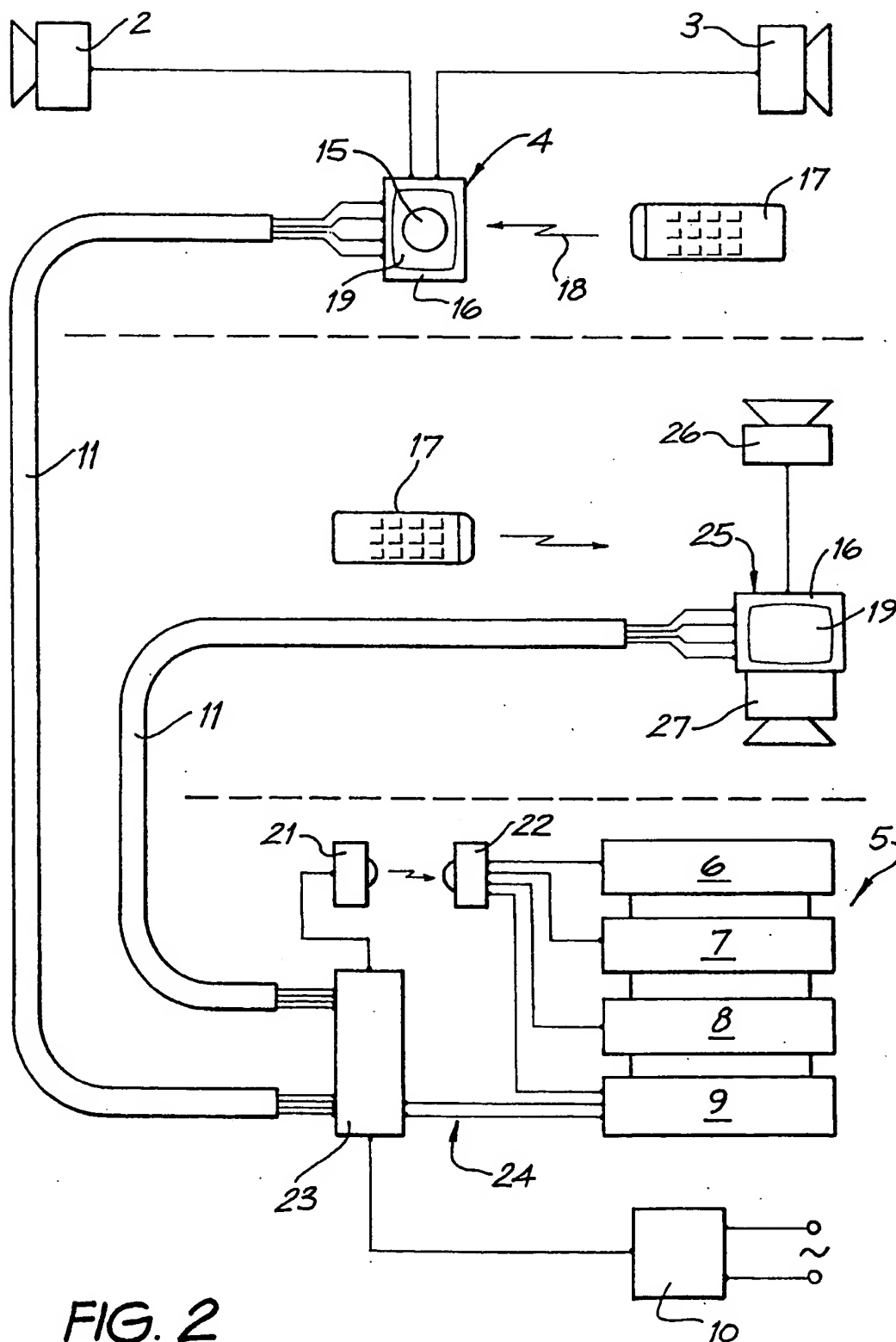


FIG. 2

SUBSTITUTE SHEET (RULE 26)

## INTERNATIONAL SEARCH REPORT

International Application No.  
PCT/AU 98/00647

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| <b>A. CLASSIFICATION OF SUBJECT MATTER</b>   |  |  |
| Int Cl <sup>6</sup> : H04R 3/12, 5/04, H04S 1/00   |  |  |
| According to International Patent Classification (IPC) or to both national classification and IPC  |  |  |
| <b>B. FIELDS SEARCHED</b>  |  |  |
| Minimum documentation searched (classification system followed by classification symbols)<br>IPC6 : as above   |  |  |
| Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  |  |  |
| Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)<br>WPAT, INSPEC, INTERNET (multiroom, audio, distributed)   |  |  |
| <b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>  |  |  |
| Category*  | Citation of document, with indication, where appropriate, of the relevant passages   | Relevant to claim No.  |
| P,X  | "Scottish Rites-Linn Knekt Multi-room System" (Jeff Cherum) Home Theater March 1998 (This article is due to be published in the magazine) whole document | 1-5  |
| Y  | "Linn Knekt Multi-room (Gold) Gramophone", December 1996, pages 198, 200 whole document  | 1-5  |
| Y  | "Multi-room hi-fi takes control of the home" (Lloyd), Times of London, 28 May 1995   | 1-5  |
| <input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C <input checked="" type="checkbox"/> See patent family annex  |  |  |
| <p>* Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&amp;" document member of the same patent family</p> |  |  |
| Date of the actual completion of the international search<br>1 September 1998  |  | Date of mailing of the international search report<br>- 9 SEP 1998       |
| Name and mailing address of the ISA/AU<br>AUSTRALIAN PATENT OFFICE<br>PO BOX 200<br>WODEN ACT 2606<br>AUSTRALIA<br>Facsimile No.: (02) 6285 3929   |  | Authorized officer<br><br>DALE E. SIVER<br>Telephone No.: (02) 6283 2196 |

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| C (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT |  |                       |
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| Category*  | Citation of document, with indication, where appropriate, of the relevant passages   | Relevant to claim No. |
| L,Y  | "The Knekt System" intermediate document from the internet page<br><a href="http://www.linn.co.uk/linn/ss/ssknt.html">http://www.linn.co.uk/linn/ss/ssknt.html</a> published on or before 4:31 PM 16 February 1998<br>also see <a href="http://www.linn.co.uk/linn/ss/ss_knt.reviews.html">http://www.linn.co.uk/linn/ss/ss_knt.reviews.html</a> | 1-5                   |
| P,A  | "MRS Multi-room Sound System" from the internet page<br><a href="http://www.midcoast.com.au/bus/me/Mrs.html">http://www.midcoast.com.au/bus/me/Mrs.html</a> published on or before 4:43 PM 16 February 1998  | 1                     |
| A  | "Home Entertainment Australia" magazine issue number one/1997 whole issue<br>see selected pages  | 1                     |
| A  | "The Facts about Firewire" (Wickelgren) IEEE Spectrum April 1997, pages 20-25 especially<br>Figures 1, 2, page 25  | 1                     |
| A  | "ADA Multi-room audio system" (Kumin) Audio Video Interiors Magazine, February 1994,<br>4 pages  | 1                     |
| A  | US 5255322 (Farenelli et al) 19 October 1993<br>abstract, figures, column 1  | 1                     |
| A  | US 5131048 (Farenelli et al) 14 July 1992<br>abstract, figures, columns 1,2  | 1                     |

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No.  
PCT/AU 98/00647

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

| Patent Document Cited in Search Report |         |    |          | Patent Family Member |         |    |          |
|--|---------|----|----------|----------------------|---------|----|----------|
| US                                     | 5255322 | AU | 34358/93 | CA                   | 2104947 | EP | 575598   |
|  |         | JP | 6505856  | MX                   | 9300119 | WO | 9314575  |
| US                                     | 5131048 | AU | 11984/92 | CA                   | 2077894 | DE | 69202925 |
|  |         | EP | 520067   | JP                   | 5505715 | MX | 9200088  |
|  |         | WO | 9212606  | US                   | 5363434 | US | 5440644  |
|  |         | US | 5666428  | US                   | 5761320 |    |          |
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